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AUTHOR Kenny, Aiden J.
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ABSTRACT

A study was conducted at Essex Community College (ECC) to test the validity of the Modified Kenny-Griffiths Test for Formal Operations, a paper-and-pencil instrument designed to determine the cognitive level of incoming adult students. The test sample consisted of 100 students (50 male and 50 female) who were equally divided between physical and social science majors. The instrument asked the students to indicate their age, sex, and major and to complete a series of problems designed to place them within three cognitive levels defined by Piaget: (1) the formal stage, at which an individual can use hypothetical reasoning; (2) the concrete operations stage, at which the individual can deal only with relationships between real, sensed objects; and (3) the pre-operations stage. As a test of the instrument's validity, the same students were administered Piaget's "Combination of Colorless Chemical Bodies" task. Correlations between the subjects' scores on the written test and the Piaget task were statistically determined, as were the influences of sex, age, and major on study outcomes. The study report discusses cognitive development and practical aspects of its measurement, Piagetian theory and its limitations when applied to collegiate learning, the need for diagnostic testing at ECC, and the lack of formal operations in adult learners. It also describes study procedures, methodology, and findings. Two versions of the test instrument are appended. (JP)

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The Development of a Diagnostic Instrument Based on a Piagetian Model

AIDEN J. KENNY

A MAJOR APPLIED RESEARCH PROJECT
PRESENTED IN PARTIAL FULFILLMENT OF THE RFQUIREMENTS FOR
THE DEGREE OF DOCTOR OF EDUCATION

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Abstract of a Major Applied Research Project
Presented to Nova University in Partial
Fulfillment of the Requirements for
the Degree of Doctor of Education

THE DEVELOPMENT OF A DIAGNOSTIC INSTRUMENT BASED ON A PIAGETIAN MODEL

by

Aiden J. Kenny

July, 1977

One of the basic assumptions underlying college instruction is that the student is able to function at the level of "formal thought" as described by Piaget. There is increasing evidence that this is not a valid assumption.

First studies by the author and recent research results indicate that approximately only 25 percent of the college population tested is operating at the level of "formal thought." The implications of this lack of ability to use formal structures, particularly in certain curricula is examined. The practical impediments of measuring cognitive development using Piaget's methodology, namely, the training of "task-givers," and the cost in time and money in order to realize the results about which significant conclusions can be drawn, are outlined. The implications and limitations of Piagetian theory for college learning are

explored. The need for diagnostic testing for cognitive level of students at Essex County College, using a simple paper and pencil test, is explained, and the implications of formal operational ability in adult learners is described.

The validation of a written instrument developed by the author and a colleague, David Griffiths, is attempted. The correlation between the results using the new instrument and those obtained using the usual, time-consuming and costly Piagetian Methodology was found to be 0.4151 using the Pearson Product Moment Scales. Recommendations for the further modification of the test for use in the collegiate setting are made. The influence of age, sex and major on the outcome are also noted.

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Chapter I

BACKGROUND AND STATEMENT OF THE PROBLEM

Cognitive Development and College Students

The basic assumption underlying college instruction is that the student is able to function at the level of formal thought as described by Piaget and his colleagues.[1] There is increasing evidence that this is not a valid assumption. Griffiths,[2] Chiappetta,[3] Haas,[4] and Billow,[5] among others, point out that many college students cannot perform the more sophisticated kinds of thought processes

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[1] J. Piaget and B. Inhelder, The Growth of Logical Thinking from Childhood to Adolescence (New York: Basic Books, 1958).

[2] D. Griffiths, "The Study of the Cognitive Development of Science Students in Introductory Level Courses" (unpublished Doctoral dissertation, Rutgers University, New Brunswick, New Jersey, 1973).

[3] E. Chiappetta, "A Perspective on Formal Thought Development" (paper presented at the Annual Conference of the National Association of Research in Science Teaching, Los Angeles, California, March, 1975).

[4] J. Haas, "For Lack of a Loom: Problems in Integrating Knowledge," Social Science and Mathematics, Vol. 75, No. 1 (January, 1975).

[5] R. Billow, "A Cognitive Developmental Study of Metaphor Comprehension," Developmental Psychology, Vol. 11, No. 4 (July, 1975), 415-423.

characteristic of formal operations.[6] That is, most are not able to make more than limited extrapolations from concrete experience to ideal representations; most have difficulty in changing frames of reference; and most cannot separate the logical structure of an argument from its content. First studies by this author[7] suggest that only 34 percent of a sample of students at a New Jersey urban community college were able to operate at the formal level. This is in keeping with a number of recent research results. Kuhn, Langer, Kohlberg and Haan[8] reported that at least 60 percent of the college age population did not achieve this criteria in an experiment to assess the presence of formal operational thought structures in normal adolescents and adults. In another study, Schwebel,[9] utilizing Piagetian tasks, tested approximately sixty randomly selected university freshmen and reported a mean score below the level of formal thinking.

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[6]For a detailed description of formal thought, see J. Piaget and B. Inhelder, The Psychology of the Child (New York: Basic Books, 1969), pp. 130-151.

[7]A. J. Kenny, "An Attempt to Measure the Level of Cognitive Development of a Sample of Essex County College Students" (unpublished practicum presented to Nova University, Fort Lauderdale, Florida, June, 1976).

[8]D. Kuhn, J. Langer, L. Kohlberg, and N. Haan, "The Development of Formal Operations in Logical and Moral Judgment" (unpublished research paper sponsored by Columbia University International Scientific Research Pool Grant, 1974).

[9]M. Schwebel, "Formal Operations in First Year College Students," Journal of Psychology, Vol. 91 (1975), 133-141.

Schwebel's work was corroborated by Keasey,[10] using similar tasks with women subjects at a state college in New Jersey. In other studies by McKinnon and Renner[11] with freshmen subjects at another university, it was found that approximately 25 percent of the sample population was operating in the formal domain.

The implications of this lack of ability to use formal structures has been pointed out by Kolodiy[12] whose work indicates that there seems to be a necessary connection between formal thinking capability and successful functioning in certain curricula, notably the physical sciences. Success in the physical sciences appears to be directly dependent on the ability to function at the level of formal operations. The implications in the social sciences are less direct. On the other hand, the logical structures of the social sciences are founded on the formal constructs, abstractions based on a study of all possible conclusions. An analysis of the logical structure of the social sciences would indicate at

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[10] C. Keasey, "Formal Operations in Females from 11-50 Years of Age," Developmental Psychology, Vol. 6 (1972), 364.

[11] J. McKinnon and J. Renner, "Are Colleges Concerned with Intellectual Development?" American Journal of Physics, Vol. 39 (1971), 1047.

[12] G. Kolodiy, "Piagetian Theory and College Science Teaching," Journal of College Science Teaching, Vol. 3 (April, 1974), 261-262.

least an indirect connection between formal thinking and successful functioning in the social sciences.

Practical Aspects of Measuring Cognitive Development

One of the main drawbacks in using Piagetian categories as a diagnostic tool for students is that the presently available procedures require carefully trained "task-givers" and are costly and time-consuming. So, while they are simple tasks that generate insight into an enormously complex process, they are individualized, extensive, "hands-on" experiments, sometimes needing special equipment and often impractical to administer to the large number of subjects necessary in order to realize results about which significant conclusions can be drawn. This situation led Tomilson-Keasey and the American Association of Physics Teachers to develop a written instrument.[13] In the light of a series of field tests of a modification of their instrument,[14] Griffiths and this author developed a modified written test.[15]

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[13]C. Tomilson-Keasey, "Introduction to Formal Operation Tasks" (Stony Brook, N.Y.: American Association of Physics Teachers, 1975). (Mimeographed.)

[14]Kenny, "An Attempt to Measure the Level of Cognitive Development of a Sample of Essex County College Students."

[15]Appendix A. The Original Kenny-Griffiths Instrument, p. 46.

The Problem

The major focus of this project is to validate and better understand the possible use of this new written instrument. The validation of this procedure for use with college students would make available an instrument for use with large numbers of students at an appreciable savings in money and time while obtaining the same results that the use of Piagetian task procedures do.

Piagetian Theory and Collegiate Learning

The following describes in essence the four major stages of growth according to Piaget. The first is the sensori-motor stage. This occurs when the child learns to coordinate perceptual and motor functions and to utilize certain elementary schemata for dealing with external objects. The child comes to know that objects exist even when outside his perceptual field and coordinates their parts into a whole recognizable from different perspectives. Elementary forms of symbolic behavior appear. The second stage is pre-operational, or representational. The external world is represented through the use of symbols, primarily by generalization from a motivation model, e.g., he believes that the sun moves because "God pushes it" and that the stars, like himself, have to go to bed. As he approaches teenage, the child moves into stage three and the ability to carry out concrete operations. These greatly enlarge his ability to

organize means independently of the direct impetus toward goal achievement; they are instruments for dealing with the properties of the immediately present object world. The fourth phase, preparatory to adult thinking, takes place during the teen years and involves formal operations. Its most important features are the development of the ability to use hypothetical reasoning based on a logic of all possible combinations, to recognize the union of various forms of reversibility, and to perform controlled experiments.[16]

Of the four stages Piaget has identified, the last two, namely, concrete and formal, concern us here. Concrete operations are adequate to deal with relationships between real, sensed objects. Using them, many, but not all, possible combinations can be developed. Real objects can be classified and additive changes in a real situation can be understood. However, a concrete thinker cannot understand or invent concepts that involve relationships between other concepts, combinations that involve three or more factors, proportionalities, the union of reversibilities, and other multiplicative changes, or changes in classifying schemes. Understanding (which in Piaget's view implies invention) of these concepts requires the ability to use formal operations.

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[16]D. Elkind, Children and Adolescence: Interpretative Essays on Jean Piaget (2nd ed.; New York: Oxford University Press, 1974), pp. 21-26.

In contrast to concrete operations, formal operations primarily involve the ability to idealize. To a formal thinker, the actual is only a subset of the possible. Individual factors in a real situation may be varied, neglected, combined, reversed, or taken to imaginary extremes in a way not possible with concrete operations. Further, the formal thinker is often more aware of his own thinking and is, thus, able to keep track of his steps better than a concrete thinker. He is able to be more objective. He can separate not only external variables, but also internal variables.[17]

If Piaget's stage theory is valid, then only those who can use formal operations are able to thoroughly grasp abstract fields of knowledge. It seems clear that the practice of scientific thought and processes implies formal operations.[18] Physics,[19] chemistry,[20] modern

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[17] R. Fuller, R. Karplus and A. Lawson, "Can Physics Develop Reasoning?" Physics Today, Vol. 30, No. 2 (February, 1977) 23-26.

[18] A. Lawson, "Relationships of Concrete and Formal Operational Science Subject Matter and the Developmental Level of the Learner" (paper presented at the National Association for Research in Science Teaching Convention, Chicago, April, 1974).

[19] F. Colles, R. Fuller, R. Karplus, L. Paldy, and J. Renner, Workshop on Physics Teaching and the Development of Reasoning (Stony Brook, N.Y.: American Association of Physics Teachers, 1975).

[20] J. Herron, "Piaget for Chemists: Explaining What 'Good' Students Cannot Understand," Journal of Chemical Education, Vol. 52, No. 2 (March, 1975), 146-150.

biology,[21] geology,[22] astronomy, ecology, medicine, and especially mathematics,[23] all use idealizations, separation of variables, concepts based on concepts, and other aspects of formal operations. And, if Anderson[24] is correct in stating that science has advanced by explaining the seeable in terms of the unseeable, then it must be that for a person to advance in scientific knowledge and to get maximum benefit from college science courses, he must be able to grasp the unseeable which requires the ability to use formal operations.

Although less clear at this point in time, the evidence is beginning to develop that work in the social sciences requires formal operations for maximum benefit. Statistical analysis, which is widely used in the social sciences, requires the comparison of the expected with the actual occurrence of events, the generation of possible combinations, probability and other concepts dependent on

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[21] N. Grant and J. Renner, "Identifying types of Thought in 10th Grade Biology Students," American Biology Teacher, Vol. 37, No. 5 (May, 1975).

[22] J. McKinnon, "Earth Science, Density, and the College Freshman," Journal of Geological Education, Vol. 19 (November, 1971).

[23] M. Galbrath, "Formidable Operations," Mathematics in School, Vol. 3, No. 4 (July, 1974), 208.

[24] C. Anderson, "Speak No Freewill (Piaget vs. Skinner)," Development Progress Report No. 38, Department of Psychology, University of Michigan, Ann Arbor, Michigan, 1974.

the above. Thus, much of psychology, sociology, and economics is beyond the grasp of those using only concrete operations.[25] The fields of history, political science and philosophy[26] may also seem much less dynamic to a concrete thinker, as he lacks the ability to consciously change frames of reference. This lack may also affect his appreciation of literature,[27] and his ability to read and write logically complex or "objective" material.[28]

What kind of learning can be expected from a concrete thinker in academic situations? When the student cannot refer to actual, sensible experience, he must resort to memorization of the vocabulary. Not fully understanding what he has memorized, he is likely to misapply the memorized vocabulary when confronted with situations which are not identical to the original context in which he "learned" the concept. He may even reject the new situation entirely,

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[25] L. Wolf, "The Development of Levels of Abstraction in Children's Thinking about Complex Social Problems" (paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois, April, 1975.

[26] Haas, "For Lack of a Loom: Problems in Integrating Knowledge."

[27] Billow, "A Cognitive Development Study of Metaphor Comprehension," 415-423.

[28] J. Cope, "Reading Difficult Writing Is a Problem-solving Process" (paper presented to the Western College Reading Association Annual Meeting, Los Angeles, California, March, 1975).

choosing to erect a barrier between the disquieting situation and his perceived "knowledge." The Griffiths study[29] shows this phenomenon clearly, pointing out that the non-formal thinkers who had mastered the vocabulary of science by memorizing formulas had apparently successfully negotiated their academic subjects, using their vocabulary (words they did not fully understand) as a defense against the collapse of their reasoning. In Piaget's words, quoted by Lengel, "Each time someone prematurely teaches a child something he could have discovered for himself, that child is kept from inventing it and consequently from understanding it completely."[30]

Herron[31] suggests our students may be harmed when confronted with content that presumes formal operations when they are concrete thinkers and, therefore, not able to grasp the concept presented. They compensate by memorizing and the teachers reward them for doing so, and unfortunately they (students) may think they have "learned" something in the process of memorizing the terminology.

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[29]D. Griffiths, "Physics Teaching: Does It Hinder Intellectual Development?" American Journal of Physics, Vol. 44, No. 1 (January, 1976), 84-85.

[30]J. Lengel, "Education for Development: An Evaluation System" (unpublished research), citing Piaget.

[31]Herron, "Piaget for Chemists: Explaining What 'Good' Students Cannot Understand," 146-150.

The foregoing suggests serious questions concerning the philosophy of education and the formulation of curricula. In addition to these basic questions, it seems important that colleges be able to ascertain, for diagnostic reasons, the cognitive stage at which their students are operating.

The Need for Diagnostic Testing of Cognitive Level at Essex County College

Essex County College is a large, urban community college located in Newark, New Jersey. It opened in 1968 to approximately 3,000 students, twice as many as expected, and has participated in the growth of the community college movement by building a new campus in the downtown area and doubling its enrollment in eight years. During this period of rapid growth, there has been a decline in preparedness of Essex students for college as measured by the Comparative Guidance and Placement Test (C.G.P.)[32] which is the most widely used instrument for initial course placement at New Jersey community colleges.[33] This trend toward lower scores on nationwide tests for college entrance is not

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[32]"Annual Report of Student Advisement and Assessment" (Newark, N.J.: Essex County College, 1975). (Mimeographed).

[33]"Information Bulletin" (Trenton, N.J.: State Department of Higher Education, July, 1976).

confined to community colleges and is a matter of some concern to colleges, legislatures and the public in general.[34]

Although most colleges do diagnostic testing of incoming students or accept and adapt the scores on nation-wide tests, e.g., Scholastic Aptitude Test (S.A.T.), American College Testing (A.C.T.), Nelson-Denny Reading, for their own purposes, and some tests like C.G.P. contain sections on student attitudes, none that this researcher has been able to discover in the literature and by informal inquiry uses a diagnostic instrument that measures cognitive stage development.

The typical Essex County College student is a twenty-seven-year-old black female who lives in her own house or apartment in Essex County within ten miles of the campus, and uses public transportation to get to class.[35] She fits the description "non-traditional" as presented by Cross.[36] She is in need of some developmental work in reading, English and/or arithmetic, and as Medsker and Tillery point out, "Compared to four-year college students

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[34]"College Scores Fall," New York Times, September 12, 1975, p. 1.

[35]"New Student Characteristic Report, 1975-76," Student Affairs (Newark, N.J.: Essex County College, May, 1976). (Mimeographed.)

[36]K. Patricia Cross, Beyond the Open Door (San Francisco: Jossey-Bass, Inc., 197-), pp. 8-9.

[she] represents a much wider range of ability and achievement, comes from a home lower in socio-economic scale, is less likely to be motivated for college work and more likely to be employed while attending college."[37]

The Limitations of Piaget's Work when Applied to College Students

Piaget's work is involved, for the most part, in exploring the thinking processes of children. His studies culminate with adolescence;[38] consequently, his own writing does not deal with adult learners. Secondly, Piaget's writings often pose difficulties for colleagues and translators; and, as mentioned above, his method of testing, of necessity, limits the widespread application of his categories for use with college students. This last limitation points up the need for a simple, written instrument. It is, in part, because of this lack of a written test which would measure cognitive development as the Piagetian tasks do that there exists so little evidence concerning the lack of ability among adult learners to operate at the level of formal thought.

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[37] L. Medsker and D. Tillery, Breaking the Access Barrier (San Francisco: Jossey-Bass, Inc., 1972), p. 24.

[38] Piaget and Inhelder, The Growth of Logical Thinking from Childhood to Adolescence.

The Lack of Formal Operations in Adult Learners

Chiapetta summarized ten recent studies and concluded that most adults and adolescents are not operating at the level of formal operation as measured by Piagetian tasks.[39] A further conclusion was that "one half or more of the individuals classified as formal operational appeared to function at the concrete level when dealing with abstract natural science material."[40] Herron makes a similar point, namely, in an unfamiliar area, a normal individual may revert to concrete operations.[41] Piaget also seems to support this view.[42] It can be assumed that the same phenomena would hold true for abstract social science content as well as other academic content areas involving abstractions such as history, literature and philosophy.

In view of the original results obtained by Piaget and Inhelder,[43] this lack of formal operations in the majority of the adult population can be interpreted as either

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[39]Chiapetta, "A Perspective on Formal Thought Development."

[40]Chiapetta.

[41]Herron, "Piaget for Chemists: Explaining What 'Good' Students Cannot Understand," 146-150.

[42]J. Piaget, "Intellectual Development from Adolescence to Adulthood," Human Development, Vol. 15 No. 12 (1972)

[43]Piaget and Inhelder, The Growth of Logical Thinking from Childhood to Adolescence.

a stage regression or a stage retardation.[44] Regardless of the cause, researchers ought to address the situation since more adults are entering the college population. One aspect of this would certainly be the development of an instrument for mass testing which would permit colleges to discover the cognitive level of incoming adult students, and the use of this information as a diagnostic tool. It would also facilitate the examination of existing strategies and exploration of new strategies for assisting students to operate at the formal level. The purpose of this study, then, is to refine and validate a pencil and paper test for mass use.

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[44] D. Bearison, "The Construct of Regression: A Piagetian Approach," Merrill-Palmer Quarterly, Vol. 20, No. 1 (January, 1974).

Chapter II

PROCEDURES AND METHODOLOGY

The Instrument

The Kenny-Griffiths Test for formal operations[1] which was initially developed in a practicum[2] and modified in light of results, was administered to one hundred Essex County College students in order to gather additional data to further examine the validity of the pencil and paper test. The testing was done during the first weeks of the Winter Semester, 1977.

The Sample

The sample consisted of one hundred students--fifty males and fifty females. They were equally divided between majors in the physical sciences and the social sciences.

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[1] Appendix B, The Modified Kenny-Griffiths Instrument, p. 60.

[2] A. J. Kenny, "An Attempt to Measure the Level of Cognitive Development of a Sample of Essex County College Students (unpublished practicum presented to Nova University, Fort Lauderdale, Florida, June, 1976).

Table 1

Distribution of the Sample of
100 Urban Community College Students

	Social Science	Physical Science
Male	25	25
Female	25	25

1. A random selection of every fourth student was made from a list of majors in the social sciences and the physical sciences. Subjects had completed between seventeen and forty-five college credits. The list used was the official computer print-out of declared majors, according to subject area generated by the Registrar's Office at the College.

2. The selected students were contacted and asked to volunteer. About 70 percent consented to particpate in the experiment. The selection process was continued until the four cells were filled.

3. The Kenny-Griffiths test for Formal Operations was administered by the researcher to small groups. In some few instances, it was necessary to make individual appointments. The test took about forty-five minutes to complete. Ten additional students had to be given the test

to replace ten subjects from the original group who were unable to keep appointments to complete the task test.

The cooperation and assistance of the Vice President of Student Affairs was obtained to initiate the described research. Access to the computer was obtained. The print-out regarding declared majors was provided by the Registrar's Office.

The Scoring

Piaget, in his criteria for administering his tasks, directs the "task-giver" to encourage the subject to discover the sought-after response. In an attempt to duplicate this attitude on the written test, the author used a self-scoring response card[3] which allowed the student to erase the area where the correct answer was thought to be. If the answer was not attained in the initial attempt, the student was encouraged to continue to erase until the correct answer was discovered. If the student answered correctly on the first try, the score was +2. If the student chose an incorrect answer on the first try, he was not penalized. If he chose the correct answer on the second try, he scored a +2. If the answer was not discovered until the third attempt, he scored zero for that

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[3]"Train-Tester," (New York: Van Valkenburg, Nooger and Neville, Inc., 1973).

question. If he made a fourth attempt and succeeded, he scored -2, and if he used all the areas to discover the answer, he scored -4.

Table 2

Scoring Guide Used for the Scoring of the Kenny-Griffiths Test for Formal Operations

Attempts at Correct Answer	1	2	3	4	5
Score	+2	+2	0	-2	-4

The test consisted of fifteen items. Because of a technical difficulty, Item 1 was omitted and fourteen items were scored. The highest possible score was, therefore, +28 and the lowest possible score was -56.

Subjects were assigned to the various Piagetian Categories more or less arbitrarily. The researcher took Piaget's criteria, that a test is not considered passed until 75 percent of the subjects tested succeed,[4] as a guideline. Negative scores were considered to be Pre-operational. The remaining possibilities between zero and 28 were divided into quadrants, as seen in Table 3.

Table 3

Category Assignments according to Scores Achieved on the Kenny-Griffiths Test for Formal Operations

Piagetian Categories		Score
Pre-operational	=	Negative Score
Concrete	=	0.0 - 10.5
Concrete-Transitional	=	10.6 - 20.9
Emergent-Formal	=	21.0 - 24.5
Consolidated-Formal	=	24.6 - 28.0

[4]J. Piaget, Judgment and Reasoning in the Child (New York: Hu-anities Press, 1952), p. 12.

Validity of the Instrument

The validity of the Modified Kenny-Griffiths Instrument was tested by administering Piaget's "Combinations of Colorless Chemical Bodies" Task[5] to the same one hundred students who had taken the written test. This was accomplished by scheduling individual appointments with each subject to take the Task Test. An average time of twenty minutes per subject was needed. The assistance of a graduate-intern was obtained to administer the chemical task to the subjects. The intern followed the guidelines as outlined.[6]

1. Correlations between the subject scores on the written test and scores on the Piagetian task were explored, using the Pearson Product Moment Scales.

2. The results were analyzed and recommendations made concerning further development of the test and possible implementation at the College.

3. In an attempt to determine whether the reading level of the sample had any influence on performance on the test, it was proposed that the

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[5]Appendix C, Description of the "Combinations of Colorless Chemical Bodies" Task, p. 78.

[6]Appendix D, Criteria and Instructions to the Interviewer, p. 81.

correlation between the reading score on the Comparative Guidance and Placement Test (C.G.P.) and success on the written test be ascertained. The Office of Advisement and Assessment at the College was contacted and arrangements made for retrieval of the scores for the subjects of the experiment. This researcher was advised that the scores would be readily available. When the testing was completed and the list of students sent to the appropriate office, the scores were not available. The reason given was that since the students were not new students the scores could not be retrieved. The lack of availability of the reading scores was a disappointment at this stage of the research. In light of the low correlation between the oral and written tests, it turned out to be a major procedural flaw in the implementation of the research design.

4. Any differences in outcome, according to the variable of sex or college major and its influence, if any, were reported. The Chi Square Test was used to test the differences.

Limitations

Caution should be exercised in applying the results of this study to other than urban community college students. Until the test is modified and validated with a more heterogeneous sample, no conclusions applicable to the general college population can be drawn.

It is also evident that the age distribution of the sample was not equivalent to the age distribution of the Essex County College student population. Therefore, any conclusion regarding age must be viewed in the light of the small numbers in the upper age categories.

Chapter III

PRESENTATION AND ANALYSIS OF RESULTS

The Sample

The sample was divided into five age categories from eighteen to fifty-plus years of age. Fifty-two percent of the subjects were between eighteen and twenty-two years of age with an additional 34 percent between twenty-three and thirty years of age, as seen in Table 4. Thus, 90 percent of the sample was in the eighteen-to-thirty age group, representing a lower average age than existed for the college student population as a whole, which for 1975-76 was estimated to be twenty-seven.[1]

Table 4

Age Distribution of a Sample of 100 Urban Community College Students

	Age Category	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
1.	18 - 22	52	52.0	52.0
2.	23 - 30	34	34.0	86.0
3.	31 - 40	9	9.0	95.0
4.	41 - 49	3	3.0	98.0
5.	50 - Above	2	2.0	100.0
		100	100.0	

The mean number of credits completed was 24.2

[1] "New Student Characteristic Report, 1975-76," Student Affairs (Newark, N.J.: Essex County College, May, 1976), p. 12. (Mimeographed.)

Controlling for sex (male), all of the humanities majors were between the ages of eighteen and thirty, while 88 percent of the male science students were also in the eighteen-to-thirty age category, as seen in Table 5, A further indication that the sample was slanted toward the young end of the Essex County College population.

Table 5

Percentage of Males in Each Age Category According to Major in a Sample of 50 Male Urban Community College Students

Age	Major: Humanities	Major: Science	Row Total
18 - 20	20*	11	31
	56.0	44.0	
	80.0	44.0	
	33.0	26.0	59.0
23 - 30	5	12	17
	20.0	80.0	
	20.0	48.0	
	7.0	30.0	37.0
41 - 49	0	2	2
	0.0	100.0	
	0.0	8.0	
	0.0	4.0	4.0
Column Total	25	25	50
	50.0	50.0	100.0

*Count
Row Pct.
Col. Pct.
Total Pct.

Controlling for sex (female), the relationship between age and major shows that 68 percent of the humanities majors were under thirty years of age, while all of the science majors fell into the eighteen-to-thirty age category, as seen in Table 6, pointing out that among the women in the sample, older women were found only in the humanities. The fact that younger females have heavier representation among science majors points to a trend at the College. The average age of Essex County College students is significantly influenced upward by the age of females in the humanities. Therefore, while the sample does not reflect the current student population, it does reflect the trend toward a younger average age for the student body as reflected in more recent data.[2]

The Results

The results on the Oral Task Test showed 43 percent of the subjects were judged to be concrete, an additional 42 percent were concrete-transitional. The emergent-formal category produced 12 percent and two percent were considered to be consolidated-formal, as seen in Table 7. This represents a lower percentage of students operating in the

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[2]"New Student Characteristic Report, 1976-77," Student Affairs (Newark, N.J.: Essex County College, September, 1977). (Mimeographed.)

Table 6

Percentage of Females in Each Age Category According to Major in a Sample of 50 Female Urban Community College Students

Age	Major		Row Total
	Humanities	Science	
18 - 22	9*	18	27
	33.3	66.7	
	36.0	72.0	
	18.0	36.0	54.0
23 - 30	8	6	14
	53.3	46.7	
	32.0	24.0	
	16.0	14.0	30.0
31 - 40	7	1	8
	87.5	12.5	
	28.0	4.0	
	14.0	2.0	16.0
50 - Above	1	0	1
	100.0	0.0	
	4.0	0.0	
	2.0	0.0	2.0
Column Total	25	25	50
	50.0	50.0	100.0

*Count
Row Pct.
Col. Pct.
Total Pct.

formal stages (12 percent) than the literature suggests (25 percent).[3] One reason for this discrepancy may be the low reading level of Essex students which may prevent some from scoring in the formal range on a Written Test.

Because of the reading difficulties in general of Essex students, it was anticipated that the subjects might score significantly lower on the Written Test than they would on the Oral Task. This proved not to be the case. If only the category of consolidated-formal is considered, as seen in Tables 7 and 8, there is slightly better performance shown on the Written Test. If, however, the formal category includes both consolidated-formal and emergent-formal, slightly better performance on the Oral Task is indicated. In either case, the differences in performance on the Written Test and Oral Task is not significant. Two factors may have influenced this unexpected result. First, the oral score reflected performance on only one task, i.e., "The Colorless Chemical Bodies Task," while the Written Test attempts to measure a series of six different cognitive skills.[4] Secondly, since the Oral Task was scored by the researcher assistant and by the researcher, the oral scores may reflect a bias. This might be offset by adding as a third scorer a disinterested person with a background in Piagetian testing.

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[3]J. McKinnon and J. Renner, "Are Colleges Concerned with Intellectual Development?" American Journal of Physics, Vol. 39 (1971), p. 1047.

[4]Appendix B. The Modified Kenny-Griffiths Instrument, p. 69.

Table 7

Frequency Distribution of Scores of a Sample of 100 Urban Community College Students on the Oral Piagetian Task

Category	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
Pre-operational	1	1.0	1.0
Concrete	43	43.0	44.0
Concrete-transitional	42	42.0	86.0
Emergent-formal	12	12.0	98.0
Consolidated-formal	2	2.0	100.0
Totals	100	100.0	

Table 8

Frequency Distribution of Scores of a Sample of 100 Urban Community College Students on the Kenny-Griffiths Test for Formal Operations

Category	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
Pre-operational (- score)	9	9.0	9.0
Concrete (0 - 10.5)	39	39.0	48.0
Concrete-transitional (10.6 - 20.9)	39	39.0	87.0
Emergent-formal (21.0 - 24.5)	10	10.0	97.0
Consolidated-formal (24.6 - 28.0)	3	3.0	100.0
Totals	100	100.0	

Using the Pearson Product Moment Scales to determine the correlation between the score on the Oral Piagetian Task and the score on the Modified Kenny-Griffiths Test for Formal Operations, the correlation (r) was 0.4151. The r squared was 0.17182, meaning that only a little over 17 percent of the sample had matching scores on the Written and Oral Tests. Although, as seen in Tables 7 and 8, the percentage of subjects scoring in the concrete and formal ranges is almost identical, a large percentage of subjects who scored in one category on one test did not duplicate that score on the other test. For example, only four subjects scored in the formal range on both Oral Task and Written Test.[5]

Controlling for sex (male), the relationship between age and score on the Oral Task can be seen in Table 9. It shows that 69 percent of the males between the ages of eighteen and twenty-two were judged to be in the concrete range, i.e., concrete and concrete-transitional, while all of the males over twenty-three were considered in the same concrete range. None of the males in the sample were judged to be consolidated formal.

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[5]Appendix E. The Total Sample, p. 84.

Table 9

Relationship between Age and Performance on the Oral Piagetian Task for 50 Male Urban Community College Students

Age	Piagetian Category: Concrete	Concrete-Transitional	Emergent-Formal	Row Total
18 - 22	17*	6	8	31
	51.5	20.0	28.5	
	62.5	35.3	100.0	
	30.0	12.0	18.0	60.0
23 - 30	7	10	0	17
	38.9	61.1	0.0	
	29.2	64.7	0.0	
	14.0	22.0	0.0	36.0
41 - 49	2	0	0	2
	100.0	0.0	0.0	
	8.3	0.0	0.0	
	4.0	0.0	0.0	4.0
Column Total	25	16	9	50
	50.0	31.2	18.8	100.0

Chi Square = 7.63269 with 4 degrees of freedom
Significance = 0.1060

*
Count
Row Pct.
Col. Pct.
Total Pct.

All of the males who transcended the concrete ranges on Oral Task 9 were in the youngest age category (18-22) as seen in Table 9, representing 30 percent of the males in that age bracket. This compares to six females, or 12 percent, distributed among three age categories, 18-40, who scored in the formal range, as seen in Table 10, and is consistent with the results of Schwebel's Study[6] which also showed that males do significantly better than females in solving Piagetian Tasks.

Elkind[7] suggests that science majors should perform better on tests for formal operations than humanities majors. This conclusion seems to be borne out by the scores of science and humanities majors on the Oral Piagetian Task as seen in Table 11. Eight science majors, or 16 percent of the science majors, scored in the formal range as compared to six humanities majors, or 12 percent of the humanities majors.

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[6]M. Schwebel, "Formal Operations in First Year College Students," Journal of Psychology, Vol. 91 (1975), 133-141.

[7]D. Elkind, "Quantity Conceptions in College Students," Journal of Social Psychology, Vol. 57 (1962), 459-465.

Table 10

Relationship between Age and Performance on the Oral Piagetian Task for 50 Urban Community College Females

Age	Piagetian Category: Pre-Operational	Concrete	Concrete-Transitional	Emergent-Formal	Consolidated-Formal	Row Total
18 - 22	0*	11	13	1	2	27
	0.0	40.7	48.1	3.8	7.4	
	0.0	64.7	50.0	25.0	100.0	
	0.0	22.0	26.0	2.0	4.0	54.0
23 - 30	0	5	8	2	0	15
	0.0	33.3	53.3	13.4	0.0	
	0.0	29.5	30.8	50.0	0.0	
	0.0	16.0	16.0	4.0	0.0	30.0
31 - 40	0	1	5	1	0	7
	0.0	14.3	71.4	14.3	0.0	
	0.0	5.8	19.2	25.0	0.0	
	0.0	2.0	10.0	2.0	0.0	14.0
50 - Above	1	0	0	0	0	1
	100.0	0.0	0.0	0.0	0.0	
	100.0	0.0	0.0	0.0	0.0	
	2.0	0.0	0.0	0.0	0.0	2.0
Column Total	1	17	26	4	2	50
	2.0	34.0	52.0	8.0	4.0	100.0

Chi Square = 37.01576 with 12 degrees of freedom
Significance = 0.0002

*Count
Row Pct.
Col. Pct.
Total Pct.

Table 11

Relationship between Major and Performance on the Oral Piagetian Task for 100 Urban Community College Students

Age	Piagetian Category					
	Pre-Operational	Concrete	Concrete-Transitional	Emergent-Formal	Consolidated-Formal	Row Total
Science	0	19*	23	7	1	50
	0.0	38.0	46.0	14.0	2.0	
	0.0	44.1	54.7	58.3	50.0	
	0.0	19.0	23.0	7.0	1.0	50.0
Humanities	1	24	19	5	1	50
	2.0	48.0	38.0	10.0	2.0	
	100.0	55.9	45.3	41.7	50.0	
	1.0	24.0	19.0	5.0	1.0	50.0
Column Total	1	43	42	12	2	100
	1.0	43.0	42.0	12.0	2.0	100.0

*Count
Row Pct.
Col. Pct.
Total Pct.

Turning to the results of the Written Test and controlling for sex (male) as seen in Table 12, nine males, or 18 percent of the males in the sample, scored in the formal range, while Table 13 points out that seven females, or 14 percent of the females in the sample, scored in the same range. All of the formal males were between the ages of eighteen and thirty, while five of the seven females fell into the eighteen-to-thirty-age category. Since the sample is skewed toward the first two age categories, 18-22 and 23-30, with 89 percent of the sample falling in that category, caution must be exercised in drawing any conclusions from the data on age and performance on the Kenny-Griffiths Test for formal operations.

Table 12

Relationship between Age and Performance on the Kenny-Griffiths Written Test for Formal Operations for 50 Urban Community College Males

Age	Piagetian Category: Pre-Operational	Concrete	Concrete-Transitional	Emergent-Formal	Consolidated-Formal	Row Total
18 - 22	4	11	10	5	1	31
	12.9	35.4	32.3	16.2	3.2	
	100.0	52.3	62.5	62.5	100.0	
	8.0	22.0	20.0	10.0	2.0	62.0
23 - 30	0	8	6	3	0	17
	0.0	47.2	35.2	17.6	0.0	
	0.0	38.0	37.5	37.5	0.0	
	0.0	16.0	12.0	6.0	0.0	34.0
31 - 40	0	2	0	0	0	2
	0.0	100.0	0.0	0.0	0.0	
	0.0	9.7	0.0	0.0	0.0	
	0.0	4.0	0.0	0.0	0.0	4.0
Column Total	4	21	16	8	1	50
	8.0	42.0	32.0	16.0	2.0	100.0

Chi Square = 8.37375 with 8 degrees of freedom
Significance = 0.3978

*Count
Row Pct.
Col. Pct.
Total Pct.

Table 13

Relationship between Age and Performance on the Kenny-Griffiths Written Test for Formal Operations for 50 Urban Community College Females

Age	Piagetian Category: Pre-Operational	Concrete	Concrete Transitional	Emergent-Formal	Consolidated-Formal	Row Total
18 - 22	3*	11	10	2	1	27
	11.2	40.8	37.3	7.4	3.3	
	60.0	61.2	50.0	40.0	50.0	
	4.7	21.7	20.0	4.0	2.0	54.0
23 - 40	1	2	9	2	0	14
	7.1	14.4	64.1	14.4	0.0	
	20.0	11.1	45.0	40.0	0.0	
	2.0	4.0	17.6	4.0	0.0	28.0
31 - 40	0	5	1	1	1	8
	0.0	62.5	12.5	12.5	12.5	
	0.0	27.7	5.0	20.0	50.0	
	0.0	10.0	2.0	2.0	2.0	16.0
50 - Above	1	0	0	0	0	1
	100.0	0.0	0.0	0.0	0.0	
	20.0	0.0	0.0	0.0	0.0	
	2.0	0.0	0.0	0.0	0.0	2.0
Column Total	5	18	20	5	2	50
	10.0	36.0	40.0	10.0	4.0	100.0

Chi square = 16.07939 with 12 degrees of freedom
Significance = 0.1876

*Count
Row Pct.
Col. Pct.
Total Pct.

Table 14

Summary of the Results on the Oral Piagetian Task and the Kenny-Griffiths Written Test according to Sex for 100 Urban Community College Students

Sex	Piagetian Category									
	Pre-Operational		Concrete		Concrete-Transitional		Emergent-Formal		Consolidated-Formal	
	Oral	Written	Oral	Written	Oral	Written	Oral	Written	Oral	Written
Male	0	4	25	21	16	16	9	8	0	1
Female	1	5	17	18	26	20	4	5	2	2
Totals	1	9	42	39	42	36	13	13	2	3

The results on the Written Test, as seen in Table 15, indicate no difference between science major and humanities majors. As mentioned above, the literature suggests that science majors should perform better on tests for formal operations as they did on the Piagetian Task used in this research experiment (see Table 11). The generally low reading level of Essex students may be responsible for some of the problems subjects had with the Written Test. Another factor may be that science majors at Essex may not have gone through the "selecting" out process common to college science majors and, according to Elkind, the reason that science majors outperform humanities majors on tests for formal operations.[8]

Many Essex students are the product of non-academic high school programs. They come to college frequently after a lapse of some years and make career choices, which translate to choice of major, not necessarily based on their academic ability. Some declare themselves to be science majors with little or no background in the physical sciences. This may be a factor, combined with poor reading skills, in explaining the lack of discrepancy between science majors and humanities majors at Essex County College in their performance on the Written Test for formal operations.

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[8]Elkind, "Quantity Conceptions in College Students," 459-465.

Table 15

Relationship between Major and Performance on the Kenny-Griffiths Test for Formal Operations for 100 Urban Community College Students

Major	Piagetian Category					Row Total
	Pre-Operational	Concrete	Concrete-Transitional	Emergent-Formal	Consolidated-Formal	
Science	2*	19	21	6	2	50
	4.0	33.0	43.0	12.0	4.0	
	22.2	48.7	58.3	46.1	66.6	
	2.0	19.0	21.0	6.0	2.0	50.0
Humanities	7	20	15	7	1	50
	14.0	40.0	30.0	14.0	2.0	
	77.8	51.3	41.7	53.9	33.3	
	7.0	39.0	15.0	13.0	1.0	50.0
Column Total	9	39	36	13	3	100
	9.0	39.0	36.0	13.0	3.0	100.0

*Count
Row Pct.
Col. Pct.
Total Pct.

Table 16

Comparison of Results on the Oral Piagetian Task with the Results on the Kenny-Griffiths Test for Formal Operations for 100 Urban Community College Students

Piagetian Category	Piagetian Oral Task	Cumulative Frequency (Percent)	Kenny-Griffiths Written Test	Cumulative Frequency (Percent)
Pre-operational	1	1.0	9	9.0
Concrete	44	45.0	39	48.0
Concrete-Transitional	43	88.0	39	87.0
Emergent-Formal	11	99.0	10	97.0
Consolidated-Formal	1	100.0	3	100.0
Total	100		100	

A comparison of the results on the Written Test with the results on the Oral Piagetian Task, as seen in Table 16, are somewhat deceptive. First, it is almost impossible to score pre-operational on the Oral Task. The one student who did was so confused by the directions that she was unable to make any effort to solve the problem presented. The Written Test, on the other hand, is able to discriminate more readily on the lower end of the scale. All minus scores were considered to be pre-operational. If the minus scores are added to the concrete range, there is an almost identical amount of subjects who score in the concrete range (including concrete-transitional), 84 percent on the Written Test and 86 percent on the Oral Task. The same is true for the formal range (emergent-formal and consolidated-formal); 15 percent score in this range on the Oral Piagetian Task and 16 percent of the subjects score in the same range on the Modified Kenny-Griffiths Test for formal operations as seen in Table 17.

However, as mentioned above, the figures are deceptive since only four of the students who scored in the formal range did so on both the Oral Task and the Written Test. The other eleven students who scored in the formal range on the Oral Task, as seen in Table 17, did not repeat in that category on the Written Test. Conversely, the other 12 students who scored in the formal range on the Written Test, as seen in Table 17, scored in the concrete range on the Oral Task.

Table 17

Comparison of the Results on the Oral Piagetian Task with the Results on the Kenny-Griffiths Test for Formal Operation (Grouped According to Range) for 100 Urban Community College Students

Piagetian Category Range	Oral Piagetian Task	Kenny-Griffiths Written Test
Concrete	84	75
Formal	15	16
Total	99*	91**

*One subject scored pre-operational on Oral Task.

**Nine subjects scored in the negative on the Written Test.

Chapter IV

CONCLUSIONS

The analysis of the data leads to the conclusion that the modified version of the Kenny-Griffiths Test for formal operations, as it is presently conceived, does not measure the same thing that is measured by the "Combinations of Colorless Chemical Bodies" Piagetian Task in enough instances to be significant. The Pearson "r" coefficient is only 0.4151. This means that 17.2 percent of the sample had matching scores on the Oral Piagetian Task and the Kenny-Griffiths Written Test.

The subjects scored slightly higher on the Written Test than on the "Combinations of Colorless Chemical Bodies" Task. No significant difference was discovered between the performance of the science majors and the humanities majors on the Written Kenny-Griffiths Test. It was expected that science majors would perform better than humanities majors as they did on the Oral Piagetian Task. The generally low reading scores of students who enroll at Essex County Community College along with somewhat unrealistic aspirations of entering students regarding careers in the sciences may be factors that contributed to this unexpected result.

Males tended to outperform females on both the Oral and Written Tests, which was anticipated and explainable in light of certain biases in the socialization process in our culture, i.e., the role expectations of males and females historically in American society.

Because the sample proved to be skewed toward the youngest age categories, it was impossible to judge accurately the effect of age on either the Oral Task or the Written Test. In subsequent experiments, greater control of the age variable should be exercised so that the average age of the sample will match more closely the average age of the population from which the sample is drawn.

One of the principal drawbacks in interpreting the data was the unavailability of the Comparative Guidance and Placement Reading Scores (C.G.P.) of the subjects. It was proposed to attempt to measure the effect of the level of reading ability on the subject's performance on the Written Kenny-Griffiths Test for formal operations. The Office of Advisement and Assessment was unable to produce the promised scores. Therefore, this aspect of the research design was not able to be implemented. In light of the results, it proved to be a significant lacuna in the conclusions that can be drawn from the data.

The unique character of the Essex County College student body must be taken into account when assessing the data. While it is well documented that roughly

25 percent of college freshmen nationwide enter college performing at the level of formal operations, this research reports only 15 percent of Essex County College students to be operating in the formal range. This statistic would seem to indicate that more research needs to be done on formal operations in urban community college populations.

Chapter V

RECOMMENDATIONS AND IMPLEMENTATION

Since the Kenny-Griffiths Test for formal operations in its present form would not be a consistent predictor of formal operations in incoming college students, and because the importance of having a reliable, simple instrument that can be administered to large numbers of students at a reasonable cost in time and money is well documented, additional modification of the written instrument should be undertaken.

It might prove helpful to use two or three Piagetian Tasks with each subject, even though this would be very time-consuming, arriving at a mean score which could be correlated with the score on the Written Test. This procedure would eliminate some of the anxiety about taking the Oral Test. It would also allow for a more accurate indication of cognitive stage development against which the Written Test could be compared. A variety of Piagetian Tasks that measure different cognitive skills might lead to a combination that would more precisely measure the same skills that the written instrument attempts to measure. This design might suggest a smaller sample with more variables.

Secondly, an item analysis of each question on the Written Test should be made in order to discover which questions best reflect the looked-for cognitive skills, and further research needs to be done among urban community college students to determine more precisely what cognitive skills are prevalent among this population.

Thirdly, a search for a more easily manageable answer sheet should be made. Many students expressed difficulty with the answer card used. It might also be helpful to explore other methods of scoring the written instrument, bearing in mind that the score should reflect the process of solving the problem.

Perhaps, most importantly, the reading scores on the Comparative Guidance and Placement Test (C.G.P.) must be obtained. If they are not, then subjects should be given a standardized reading test such as the Nelson-Denny so that this variable can be tested.

It is further recommended that the Pilot Project introduced in the Fall Semester of 1977 at Essex County College[1] to implement learning strategies based on cognitive stage development, have as one of its priorities the further modification of the Kenny-Griffiths instrument. A written instrument would seem to be a necessity if the results of the pilot program are to be applicable to any large numbers of student body at Essex County College and tested outside the institution.

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[1]Appendix F. The Cognitive Program at Essex County College, p. 89.

One of the main problems facing colleges today is the question of what to do about remediation. If cognitive stage development can be reliably and efficiently measured, the results will be able to be used to instigate a different approach to underprepared college freshmen. If it is clear that a majority of beginning college students are not formal operators and that formal thinking skills are necessary to negotiate college level courses without using compensatory skills like memory, then it becomes important that college instruction reflect this phenomena. It is the assumption of the fledgling college programs based on Piaget's Cognitive Stage Theories that the so-called basic skills can be more readily mastered if the student is simultaneously being moved toward formal operations.

Correspondence[2] with other colleges and universities around the country, which are working in a similar vein, leads this researcher to be optimistic about a major breakthrough in a more easily measuring cognitive development and in developing strategies to fulfill the potential of a majority of college-bound students who for various reasons are not yet formal thinkers.

Perhaps, together we will be able to develop the simple, reliable instrument we need to further explore the possibilities of applying the insights of Jean Piaget to adult learners.

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[2]Appendix G. List of Cognitive Stage Development Projects for College Students in the United States, p. 92.

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APPENDIXES

Appendix A

THE ORIGINAL KENNY-GRIFFITHS INSTRUMENT

COGNITIVE TEST

A. Materials

1. Test Booklet (12 pages)
2. Answer Card
3. Pencil with eraser

B. Instructions

1. This test contains six (6) problems that have been given to many people in a different form. The drawings for each problem are presented to help you understand the physical experiment upon which the questions are based.

2. After reading the given information and studying the drawings, read the questions and try to determine the letter of the correct answer.

3. Carefully erase the blackened spot on the answer card that corresponds to your answer.

4. Under this spot, you will find a letter, either H, L, T, I, or E.

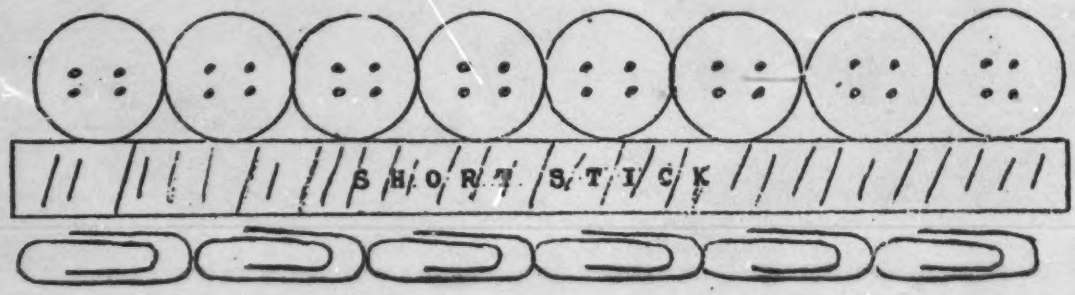
5. If the letter you see is the same as the letter in the brackets [ ] following each question, then you know you have picked the answer which is considered correct by most people.

6. If your answer does not agree, you may do the problem again and select another answer.

7. For each answer chosen, a reason MUST BE WRITTEN in the test booklet in order to get credit.

THE MEASURING PROBLEM

A man and his wife wanted to measure the length of the stick shown below but did not have a ruler. The woman decided to measure it by placing round buttons side-by-side from one end of the stick to the other. She found its length to be eight (8) buttons. She then measured a longer stick in the same way with the same buttons and found it to be twelve (12) buttons long.



The man then measured the short stick with paper clips and found it to be six (6) paper clips long.

1. What would be the length of the longer stick if he measured it with the same size paper clips? (L)

   a) 12 paper clips
   b) 10 paper clips
   c) 9 paper clips
   d) 8 paper clips
   e) cannot tell from the given information

My reason: _____

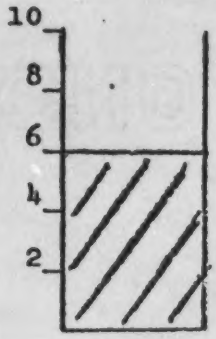
_____

_____

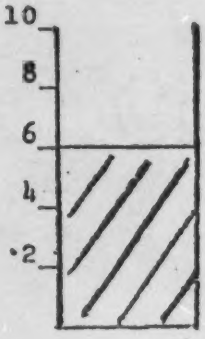
_____

THE VOLUME PUZZLE

Here are drawings of two vertical tubes (cylinders) which are filled to the same mark with water. The cylinders are identical in size and shape.



Cylinder I



Cylinder II

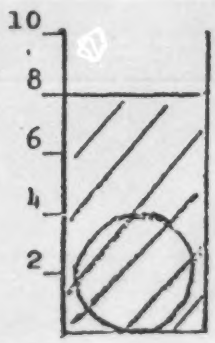
Here are two marbles, one made of steel and one made of glass. Both marbles are the same size. The steel marble is heavier.

Glass

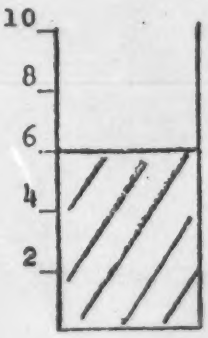
Steel

The steel marble is twice as heavy as the glass one. Both marbles will sink if placed in the cylinders.

After we have put the glass marble in Cylinder I, both cylinders and their contents look like this:



Cylinder I



Cylinder II

2. If we now put the steel marble into Cylinder II, the water level will... (H)

a. not change
b. fall
c. rise
d. cannot tell from given information

REASON: _____

_____

_____

(4)

VOLUME PUZZLE

3. When the steel marble is in the water of Cylinder II, the water level will be...(T)

a. at the six mark
b. at the eight mark
c. at the ten mark
d. cannot tell from given information

REASON:_____

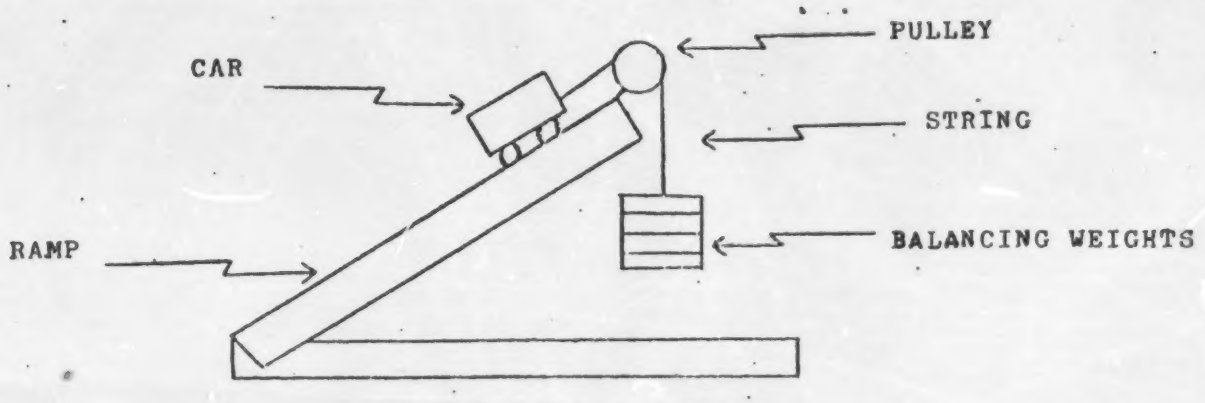
_____

_____

_____

BALANCE HILL

A father built his child a toy which is shown in the diagram below. It is called a balance hill and has three major parts: the ramp, the car, and the balancing weight.



The object of the toy is to balance the car with the right weights so that it will not move up or down the ramp. The car weighs 5 pounds.

4. When the car is in the position shown in the diagram, the balancing weight must be: (+)

   a) 5 pounds
   b) more than zero, but less than 5 pounds
   c) more than 5 pounds
   d) zero pounds
   e) cannot tell from the given information

   My reason: _____

   _____

   _____

   _____

   _____

5. If the ramp is made steeper, will the new balancing weight be: (I)

a) more than before
b) less than before
c) the same as before
d) cannot tell from the given information

My reason:

If the ramp can be placed in any position from straight up and down to flat on the table:

6. The biggest weight ever needed to balance the car would be: (E)

a) 5 pounds
b) more than zero, but less than 5 pounds
c) more than 5 pounds
d) zero pounds
e) cannot tell from the given information

My reason:

7. The smallest weight ever needed to balance the car would be: (T)

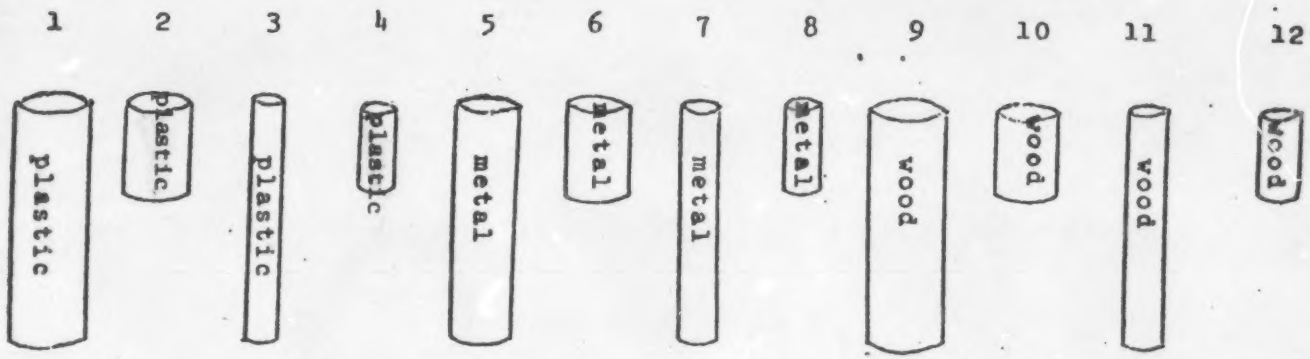
a) 5 pounds
b) more than zero, but less than 5 pounds
c) more than 5 pounds
d) zero pounds
e) cannot tell from the given information

My reason:

(7)

THE BENDING PROBLEM

You are working on a problem involving bending of rods and are trying to figure our which is easier to bend. You are working with the following rods.



8. Which rods could you compare to find out if long rods bend more easily than short rods? (L)

   a) rods 1 and 12
   b) rods 1 and 6
   c) rods 1 and 4
   d) rods 1 and 3
   e) rods 1 and 2

   My reason:

9. Could you compare rods 2 and 3 to find out if long rods bend more easily than short rods? (L)

   a) yes
   b) no
   c) cannot tell from given information

   My reason:

(8)

BENDING PROBLEMS

10. What rods could you compare to find out if metal rods bend more easily than wood rods? (L)

    a) rods 6 and 12
    b) rods 6 and 11
    c) rods 6 and 10
    d) rods 6 and 9
    e) rods 6 and 8

My reason:

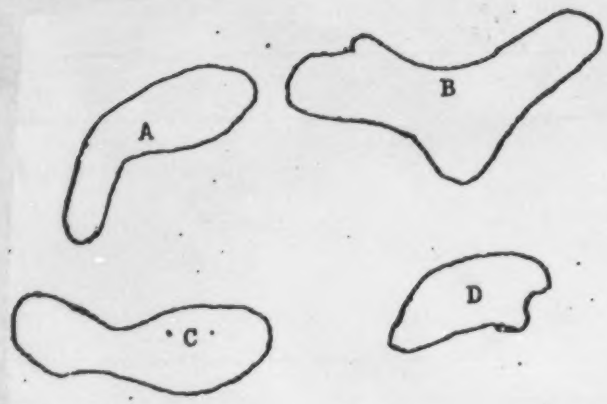
11. Could you compare rods 5 and 11 to find out if metal rods bend more easily than wood rods? (T)

    a) yes
    b) no
    c) cannot tell from given information

My reason:

THE ISLAND PUZZLE

The puzzle is about Islands A, B, C, and D in the ocean. People have been traveling among these islands by boat for many years, but recently an airline started in business. Carefully redd the clues about possible plane trips. The trips may be direct or include stops on other islands. When a trip is possible, it can be made in either direction between the islands. You may make notes or marks on the map to help use the clues.



First Clue: People can go by plane between Islands C and D.

Second Clue: People cannot go by plane between Islands A and B.

Use these two clues to answer Question 12. Do not read the next clue yet.

12. Can people go by plane between Islands B and D? (H)

a) yes
b) no
c) cannot tell from the two clues.

REASON:

Third Clue: People can go by plane between Islands B and D.

Use all three clues to answer Questions 13 and 14.

ISLAND PUZZLE

13. Can people go by plane between Island B and C? (T)

a) yes
b) no
c) cannot tell from the three clues

REASON:

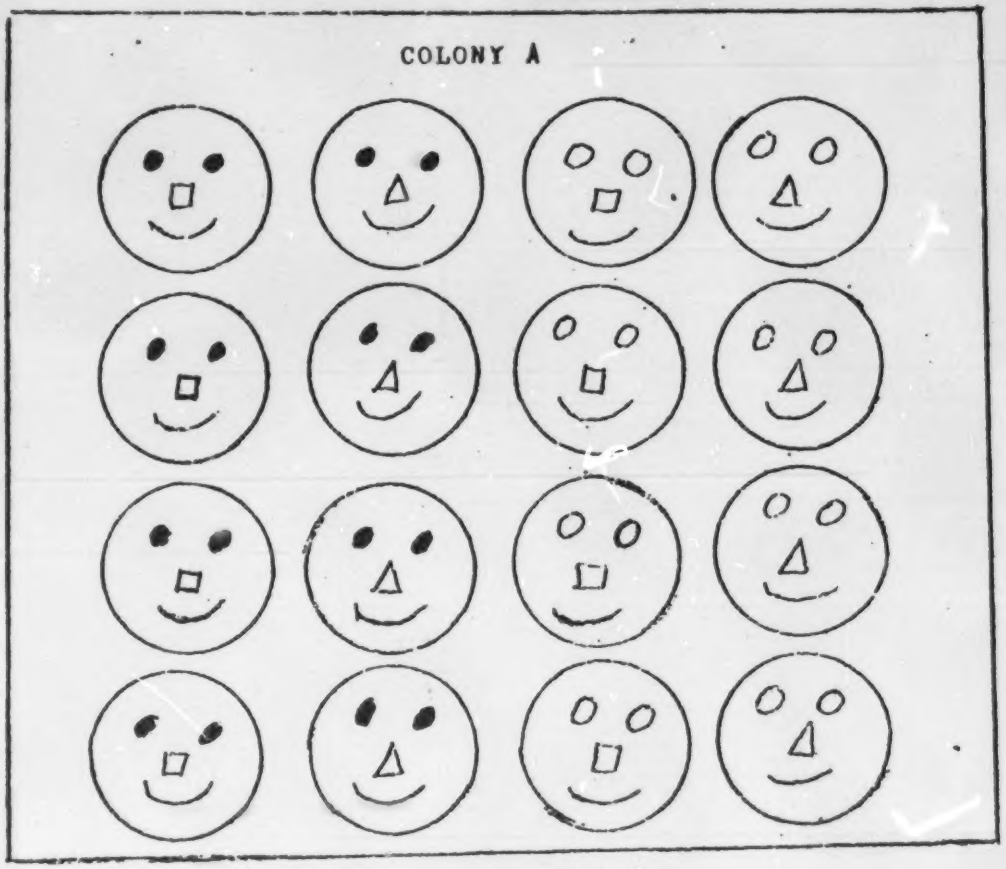
14. Can people go by plane between Islands A and C? (H)

a) yes
b) no
c) cannot tell from the three clues

REASON

THE ODDS PROBLEM

This problem involves the relationship between eye color which may be black or white and nose shape which may be a square or triangle of an animal "Darus." Your problem is to examine each set of faces in the colony and tell how strong the relationship is between eye color and nose shape.



Use Only for Question 15

You are told that a Darus from Colony A has white eyes and are asked to predict what shape its nose will be.

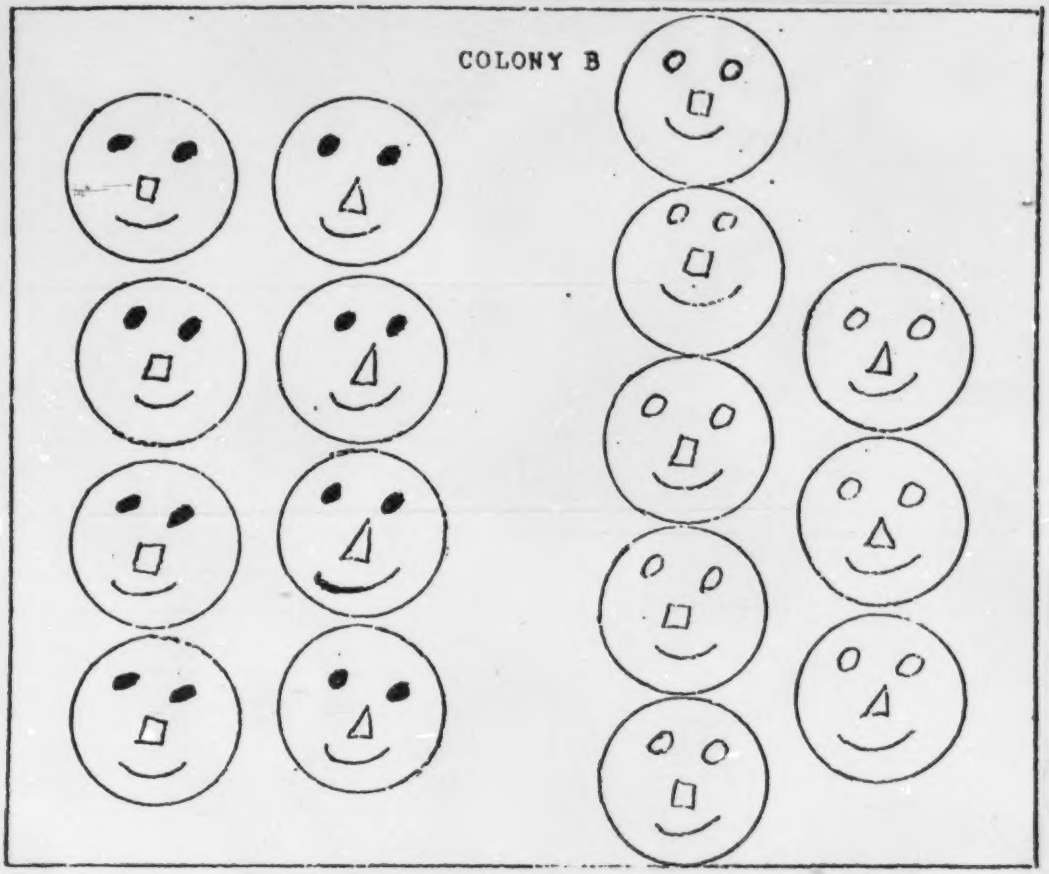
15. What is your chance of being right? (E)

a. 0% chance
b. 25% chance
c. 50% chance
d. 75% chance
e. cannot tell from the information given.

REASON:

THE ODDS PROBLEM

Before visiting the Darus reservation you are told that black eyes are usually associated with square noses. You want to establish whether or not this relationship between black eyes and square noses is true.



Use for Questions 16 & 17

16. The total number of cases which tend to support or confirm the relationship between black eyes and square noses is? (T)

a. 0 - cases
b. 4 - cases
c. 7 - cases
d. 8 - cases
e. 9 - cases

REASON:

THE ODDS PROBLEM

17. The total number of cases which tend not to support or confirm the relationship is: (H)

a. 0-cases
b. 4-cases
c. 7-cases
d. 8-cases
e. 9-cases

REASON:

APPENDIX B

THE MODIFIED KENNY-GRIFFITHS INSTRUMENT

WHAT THE TEST ATTEMPTS TO DISCOVER

Question I. The Measuring Problem

Attempts to discover whether or not the subject can use proportionality. The formal thinker should be able to deal with ratio and proportion.

Question II. A Volume Puzzle

Attempts to establish the subject's ability to conserve volume, which is the most advanced type of conservation. The formal thinker will be able to conserve volume.

Question III. The Balance Hill

Attempts to measure the ability to apply the concept of limits. The formal thinker should be able to apply the concept.

Question IV. The Bending Problem

Attempts to establish the ability to hold one variable constant while manipulating other variables. This skill includes the ability to isolate one variable. The formal thinker will be able to demonstrate the ability to isolate and manipulate variables.

Question V. The Relationship Problem

Attempts to measure the subject's ability to recognize correlations. The formal thinker will be able to see the relationship between one variable and other variables.

Question VI. The Odds Problem

Attempts to measure the subject's ability to compute the odds that any given event will occur given the possible variations.

COGNITIVE TEST

A. MATERIALS

1. Test Booklet (12 pages)
2. Answer Card
3. Pencil with eraser

B. INSTRUCTIONS

1. This test contains six (6) problems that have been given to many people in a different form. The drawings for each problem are presented to help you understand the physical experiment upon which the questions are based.

2. After reading the given information and studying the drawings, read the questions and try to determine the letter of the correct answer.

3. Carefully erase the blackened spot on the answer card that corresponds to your answer.

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5. If the letter you see is the same as the letter in the brackets [ ] following each question, then you know you have picked the answer which is considered correct by most people.

6. If your answer does not agree, you may do the problem again and select another answer.

7. For each answer chosen, a reason SHOULD BE WRITTEN in the test booklet in order to get credit.

C. NAME _____

SS# _____

SEX ☐ Male ☐ Female

AGE ☐ 18-22 ☐ 23-30 ☐ 31-40 ☐ 41-49 ☐ Over 50

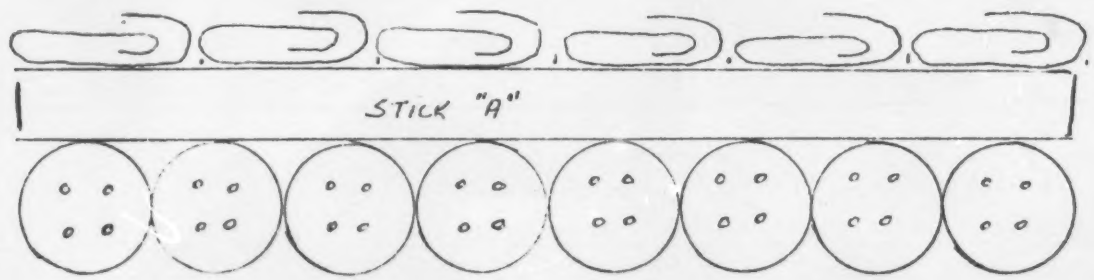
MAJOR ☐ Science ☐ Social Science

Number of Credits Completed _____

Test for Formal Operations

I. THE MEASURING PROBLEM

A man and his wife wanted to measure the length of the stick "A" shown below but did not have a ruler. The woman decided to measure it by placing round buttons side-by-side from one end of the stick to the other. She found its length to be eight (8) buttons. She then measured another stick "B" (not shown) in the same way with the same buttons and found it to be twelve (12) buttons long.



The man then measured the stick "A" with paper clips and found it to be six (6) paper clips long. (+)

1. Which stick is longer:

   a. stick "A"
   b. stick "B"
   c. they are equal length
   d. cannot tell from the given information.

2. What would be the length of the stick "B" if he measured it with the same size paper clips? (H)

   a. 12 paper clips
   b. 10 paper clips
   c. 9 paper clips
   d. 8 paper clips
   e. cannot tell from the given information

   Reason:

II. A VOLUME PUZZLE

Below is a drawing of a glass containing water and next to it three metal blocks.

3. What will happen to the water level when we carefully place the blocks in the glass one on top of each other. (E)

   a. no change
   b. fall
   c. rise
   d. cannot tell from given information

Below is a drawing of the stacked blocks in the glass of water.

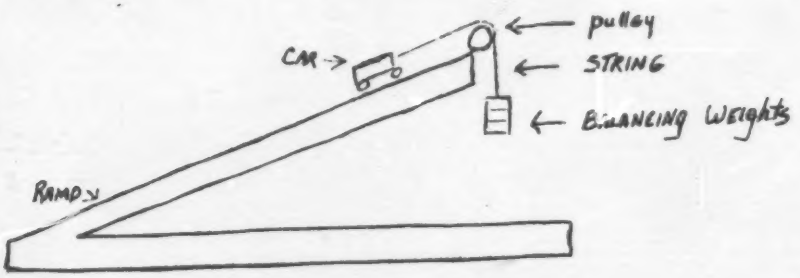
4. What will happen to the water level in the glass if we knock over the stack of blocks. (H)

   a. no change
   b. fall
   c. rise
   d. cannot tell from the information given.

   Reason:

III. BALANCE HILL

A father built his child a toy which is shown in the diagram below. It is called a balance hill and has three major parts: the ramp, the car, and the balancing weight.



The object of the toy is to balance the car with the right weights so that it will not move up or down the ramp. The car weighs 5 pounds, the balancing weight is 3 pounds and the car is balanced.

If you move the ramp up or down in order to make it more steep or less steep,

5. The biggest weight ever needed to balance the car would be: (+)

   a. 5 pounds
   b. more than zero, but less than 5 pounds
   c. more than 5 pounds
   d. zero pounds
   e. cannot tell from the given information

   REASON:

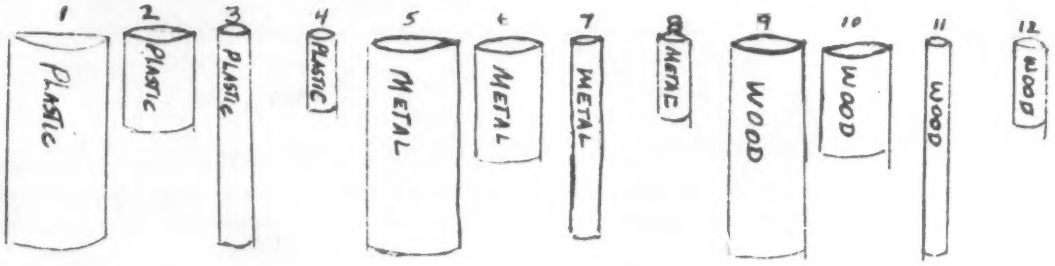
6. The smallest weight ever needed to balance the car would be: (+)

   a. 5 pounds
   b. more than zero, but less than 5 pounds
   c. more than 5 pounds
   d. zero pounds
   e. cannot tell from the given information

   REASON:

IV. THE BENDING PROBLEM

You are working on a problem involving the bending of rods and are trying to figure out which one is easiest to bend. You are working with the following rods.



7. Which rods could you compare to find out if long rods bend more easily than short rods? (E)

   a. rods 1 and 12
   b. rods 1 and 6
   c. rods 1 and 4
   d. rods 1 and 3
   e. rods 1 and 2

   Reason:

8. Could you compare rods 2 and 3 to find out if long rods bend more easily than short rods? (H)

   a. yes
   b. no
   c. cannot tell from the given information

   Reason:

9. What rods could you compare to find out if metal rods bend more easily than wood rods? (+)

a. rods 6 and 12
b. rods 6 and 11
c. rods 6 and 10
d. rods 6 and 9
e. rods 6 and 8

Reason _____

_____

_____

10. Could you compare rods 5 and 11 to find out if metal rods bend more easily than wood rods? (E)

a. yes
b. no
c. cannot tell from given information

Reason _____

_____

_____

V. The Relationship Problem

A Social Scientist is trying to prove that rich people will always live in large houses. For his study he labels people as being either rich or poor and their houses as being either large or small.

	RICH	POOR
LARGE HOUSE	8,000	2,500
SMALL HOUSE	500	10,000

11. According to the table, how many people were both rich and lived in small houses (†)

a. 500
b. 2,500
c. 8,000
d. 10,000

12. The total number of people which tend to confirm or support the statement that "You must be rich in order to live in a large house" is (E)

a. 8,000
b. 8,500
c. 10,500
d. 11,000
e. 18,000

13. The total number of people which tend to disprove the statement that "you must be rich in order to live in a large house is (†)

a. 500
b. 3,000
c. 8,500
d. 10,500
e. 18,500

THE ODDS PROBLEM

You have 75 red balls and 25 white balls in a bag.

14. What are the odds of putting your hand in the bag and pulling out a red ball? (L)

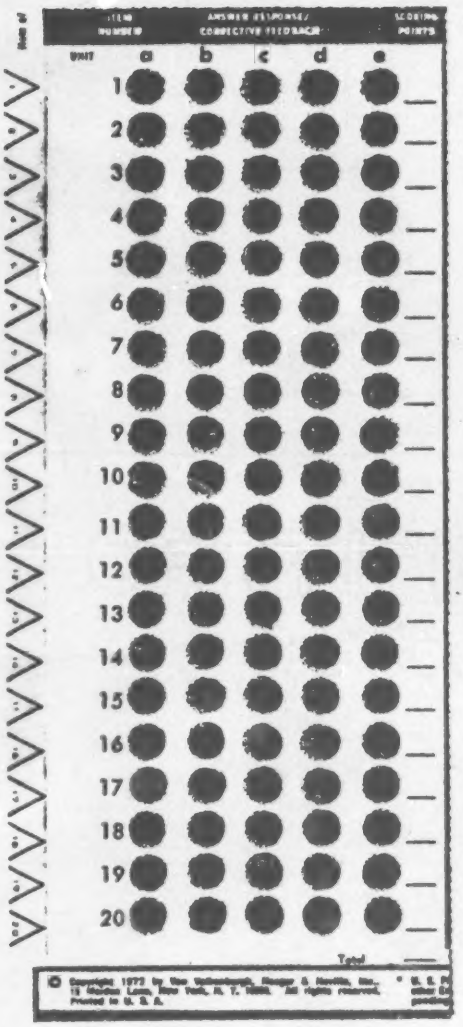
a. one out of four
b. one out of three
c. two out of four
d. three out of four
e. four out of four

15. Assume you get a red ball on your first pick and you put the red ball back into the bag. What are the odds of putting your hand in the bag and getting a red ball again? (T)

a. one out of four
b. one out of three
c. two out of four
d. three out of four
e. four out of four

A note on the use of this answer sheet.

The researcher was more interested in the process of obtaining the correct answer than the right answer. I felt that giving the student immediate feedback and allowing him one free answer would allow the student to develop a sense of the process as the goal.



APPENDIX C

A DESCRIPTION OF THE "COMBINATIONS OF COLORLESS CHEMICAL BODIES" TASK

There are four beakers of colorless liquids labeled 1, 2, 3 and 4, and a small vial labeled "9". Each container has a dropper for the purpose of transferring the liquids. The first beaker contains dilute sulfuric acid; the second, water; the third, very dilute hydrogen peroxide; the fourth, sodium thio-sulfate; and "g" potassium iodide. Before beginning the testing procedure, two mixtures of colorless solutions are prepared in unmarked paper cups. The list contains liquid 2 and the other 1 and 3.

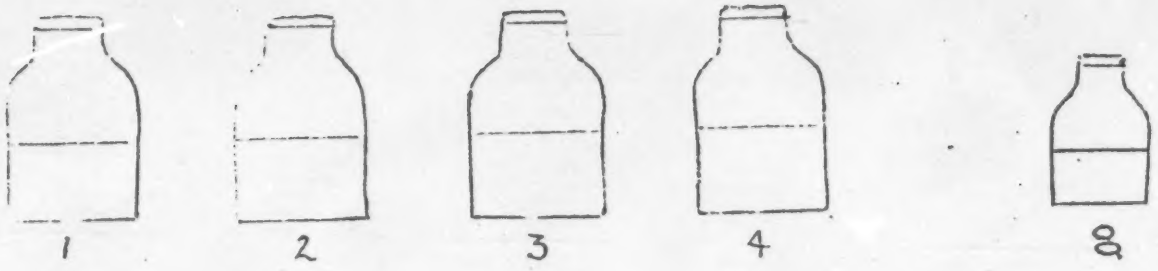
The hydrogen peroxide, in an acid medium, will oxidize potassium iodide to product a yellow color. Thus a mixture and (1) + (3) + (9) provides the solution. Water (2) is neutral, while the sodium thio-sulfate bleaches the mixture.

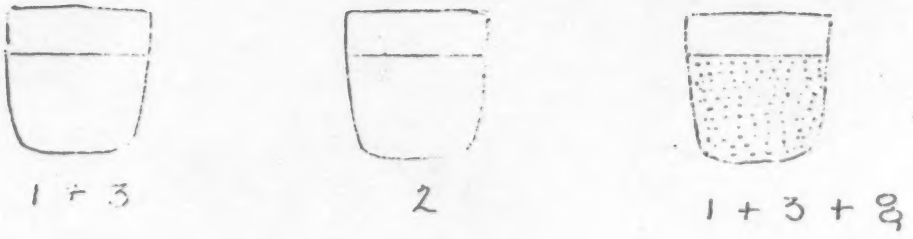
The experimenter, in the presence of the subject, adds a few drops of "9" to each of the prepared cups and notes the different reactions. The subject is then asked to reproduce the yellow color, using any or all of the five liquids as he wishes.

From the Piagetian frame of reference, this experiment demonstrates the existence of the combinatorial system which is necessary for the formation of propositional logic, the hallmark of formal thought.

(1)

(2)





APPENDIX D

CRITERIA AND INSTRUCTIONS TO THE INTERVIEWER

Pen and paper will be on the table for the subject, but not mentioned. The administrator of the task will make a preliminary evaluation of the subject. Notes will be made and each session will be taped. Based upon the observations of the experimenter, a category was assigned to each individual. The tape and notes will then be given to the researcher for his judgment.

The average of the two evaluations will be reported.

The following scale was used:

Stage IIA Early Concrete

1. will produce N X N combination, but very unsystematically;
2. subjects will not try N X N X N combinations without suggestion from the experimenter;
3. cannot find the role of 2 and 4 even when urged to do so;
4. thinks a single chemical produces the color;

Stage IIB Concrete

1. will spontaneously produce systematic N X N combinations;
2. uncertain that a combination of chemicals are needed to produce color;
3. effect of 4 is found by chance, but not tested.

Stage IIIA Emergent Formal

1. uses a system to produce combinations, but cannot generate

(1)

all possibilities once the color is produced;

2. will seek the role of 2 and 4 when questioned by the experimenter.

Stage IIIB Consolidated Formal

1. subject is very systematic in his experiment and uses the pen and paper to keep track of his efforts;
2. All possible combinations are examined;
3. spontaneously finds the role of 2 and 4.

APPENDIX E

THE TOTAL SAMPLE

TOTAL SAMPLE

Student No.	Sex	Age*	Major	Oral	Written	Raw Score**
1	M	2	Science	2	3	(22)
2	F	1	Science	3	2	(18)
3	M	2	Science	2	2	(18)
4	M	1	Science	3	2	(16)
5	M	2	Science	2	2	(20)
6	F	1	Science	2	3	(22)
7	M	1	Science	1	2	(20)
8	F	1	Science	2	1	(10)
9	F	1	Science	2	1	(4)
10	M	1	Science	3	1	(8)
11	M	3	Science	1	1	(2)
12	M	2	Science	2	1	(10)
13	F	2	Science	2	2	(18)
14	M	1	Science	2	3	(24)
15	F	2	Science	3	2	(18)
16	M	1	Science	1	2	(12)
17	F	1	Science	1	1	(6)
18	M	2	Science	1	1	(8)
19	M	2	Science	1	1	(8)
20	M	2	Science	1	1	(10)
21	F	1	Science	1	3	(24)
22	F	1	Science	1	0	(-4)
23	F	1	Science	1	2	(16)
24	F	2	Science	1	2	(18)
25	F	1	Science	2	1	(10)

Student No.	Sex	Age*	Major	Oral	Written	Raw Score**
26	F	1	Science	2	0	(-6)
27	F	2	Science	1	2	(12)
28	M	1	Science	3	4	(26)
29	F	3	Science	2	3	(24)
30	F	1	Science	2	2	(18)
31	M	2	Science	2	3	(12)
32	M	2	Science	2	1	(10)
33	M	2	Science	2	3	(24)
34	F	1	Science	2	3	(18)
35	M	3	Science	1	1	(6)
36	M	2	Science	1	1	(4)
37	F	1	Science	4	4	(26)
38	M	1	Science	1	1	(2)
39	M	2	Science	2	2	(14)
40	M	1	Science	1	1	(8)
41	F	1	Science	2	2	(16)
42	M	1	Science	1	1	(18)
43	F	1	Science	2	1	(10)
44	F	1	Science	2	2	(12)
45	F	1	Science	1	1	(2)
46	M	1	Science	1	1	(2)
47	M	1	Science	3	2	(18)
48	F	1	Science	2	3	(12)
49	F	2	Science	3	2	(14)
50	F	2	Science	2	2	(16)

Student No.	Sex	Age*	Major	Oral	Written	Raw Score**
51	M	1	Humanities	3	2	(16)
52	F	3	Humanities	2	1	(8)
53	F	3	Humanities	3	2	(14)
54	F	2	Humanities	2	0	(-6)
55	M	1	Humanities	1	0	(-8)
56	F	2	Humanities	2	1	(10)
57	F	1	Humanities	1	1	(0)
58	M	1	Humanities	2	1	(10)
59	F	3	Humanities	2	1	(6)
60	F	1	Humanities	2	2	(20)
61	M	1	Humanities	1	2	(12)
62	F	1	Humanities	4	2	(20)
63	M	1	Humanities	1	2	(18)
64	M	2	Humanities	1	3	(22)
66	F	3	Humanities	2	4	(26)
67	M	1	Humanities	1	0	(-4)
68	F	1	Humanities	1	1	(6)
69	F	2	Humanities	1	2	(16)
70	M	2	Humanities	2	1	(2)
71	F	3	Humanities	1	1	(0)
72	F	2	Humanities	1	2	(14)
73	M	1	Humanities	2	3	(24)
74	F	1	Humanities	1	1	(2)
75	M	1	Humanities	1	2	(14)
76	F	1	Humanities	1	2	(12)
77	F	1	Humanities	1	1	(0)

Student No.	Sex	Age*	Major	Oral	Written	Raw Score**
78	M	1	Humanities	2	1	(2)
79	M	1	Humanities	1	0	(-4)
80	F	5	Humanities	0	0	(-46)
81	M	1	Humanities	1	1	(6)
82	M	2	Humanities	2	2	(12)
83	M	1	Humanities	1	2	(16)
84	F	2	Humanities	2	3	(24)
85	M	1	Humanities	3	2	(20)
86	M	1	Humanities	2	1	(4)
87	F	1	Humanities	1	0	(-6)
88	M	2	Humanities	1	1	(8)
89	M	1	Humanities	2	3	(24)
90	F	2	Humanities	2	3	(18)
91	F	2	Humanities	2	3	(22)
92	M	1	Humanities	1	0	(-2)
93	M	1	Humanities	3	3	(22)
94	M	1	Humanities	2	1	(10)
95	F	3	Humanities	2	1	(6)
96	M	1	Humanities	3	3	(24)
97	F	3	Humanities	1	1	(4)
98	F	2	Humanities	1	1	(4)
99	M	2	Humanities	1	2	(12)
100	M	1	Humanities	1	1	(6)

*Age
1 = 18 - 22
2 = 23 - 30
3 = 31 - 40
4 = 41 - 49
5 = 50 and over

**Raw Score on the Written Test
Pre-operational = minus score
Concrete = 0. - 10.5
Concrete-Transitional = 10.6 - 20.9
Emergent-Formal = 21.0 - 24.5
Consolidated-Formal = 24.6 - 28.0

APPENDIX F

THE COGNITIVE PROGRAM

ESSEX COUNTY COLLEGE

NEWARK, NEW JERSEY

THE COGNITIVE PROGRAM

ESSEX COUNTY COLLEGE

INTRODUCTION:

The Cognitive Program is specially designed for freshman students beginning their college careers. It consists of a core of four courses - English, sociology, science and education. The courses in the Cognitive Program are from the mainstream of the college offerings and apply towards degree requirements and transfer needs of other institutions.

LIST COURSES:

ENG 091 ENGLISH FOUNDATIONS **4.5 credits**

This course develops the basic writing skills necessary for achieving success in college courses. Successful completion of this course prepares the student for ENG 101. Covered are such essential topics for the development of writing skills as sentence structure, punctuation, writing styles, and the larger units of composition, such as the paragraph essay. It is possible to complete the requirements for ENG 101 for degree credit.

SOC 101 INTRODUCTION TO SOCIOLOGY **3 credits**

This course introduces the student to the notion of society, as a framework within which all people live their lives, and the factors or processes determining the structure or shape of society. Concepts and processes such as social institutions, social stratification, ideologies, and social change will be discussed and clarified.

EDU 201 EDUCATION IN AN URBAN ENVIRONMENT **3 credits**

An examination of the educational and social forces affecting the learning process of the inner city student. Some issues to be examined: Cultural pluralism and the educational system, the effect of social institutions on the educational process and the role of the teacher in the urban school.

SCI 121 STRUCTURE OF SCIENTIFIC THOUGHT **4 credits**

The development of scientific ideas beginning with real experiences in the world to the creation of sophisticated theories. The course is based upon student activities and laboratory work.

PSY 101 GENERAL PSYCHOLOGY - PERSONALITY AND SOCIAL ASPECTS **3 credits**

An introductory course which examines the history, methodology, definitions and ideas relating to such concepts as personality formation, self concept, defense mechanism, emotions and conditioning. Emphasis is placed on the relationship of these concepts to the student's understanding of himself and others in everyday interactions.

PURPOSE:

Many college students typically use reasoning skills below the levels demanded by college instruction. Within the framework of the Cognitive Program, the student will develop the ability to reason more effectively while also receiving information and insight into the various major disciplines.

Students who are seeking a career, as well as those who have already selected their career, will find the Cognitive Program an ideal way to start their college education.

The Cognitive Program is based on the research and writings of Jean Piaget foremost in the fields of educational theory, intellectual development and psychology.

ADVANTAGES:

1. Class meets from 9:00 a.m. to 2:45 p.m., Monday through Friday.
2. Financial aid is available.
3. Close interaction with a team of faculty who will teach in the Program.
4. Small classes - an opportunity to get to know other students.
5. Use of new teaching techniques which stress the *active* involvement of the students.
6. Emphasis is placed on the student in the learning process.
7. Opportunities for individual tutoring and assistance and counseling.

FACULTY

GRIFFITHS, DAVID H.
Associate Professor, Engineering Technologies and Physical Sciences
B.A., Montclair State College
M.S., Adelphi University
Ed.D., Rutgers University

MacMAHON, MILES D.
Associate Professor, Engineering Technologies and Physical Sciences
B.S., University of Maryland
M.S., Temple University

ULESKY, ROBERT
Assistant Professor, Education
B.S., Seton Hall University
M.A., Montclair State College

ROGERS, LAURA
Assistant Professor, Counseling and Career Development
B.A., Queens College
M.A., Queens College

KENNY, AIDEN
Assistant Professor, Behavioral Science
B.S., College of The Holy Cross
B.A., Seton Hall University
M.A., Manhattan College

ROBINSON, HAROLD
Assistant Professor, Languages and Literature
B.A., Rutgers University
Ed.M., Rutgers University

HALPER, FRED
Assistant Professor, Behavioral Science
B.A., University of Vermont
M.A., Yeshiva University
Ph.D., Rutgers University

PHONE 877-3155

APPENDIX G

LIST OF COGNITIVE STAGE DEVELOPMENT PROJECTS

FOR ADULT LEARNERS IN THE UNITED STATES

LIST OF COGNITIVE STAGE DEVELOPMENT PROJECTS FOR ADULT LEARNERS IN THE UNITED STATES

ADAPT

A Piagetian-based Program for College Freshmen
University of Nebraska-Lincoln
Lincoln, Nebraska 68588

DOORS

The Doors Program
Illinois Central College
Box 2400
East Peoria, Illinois 61635

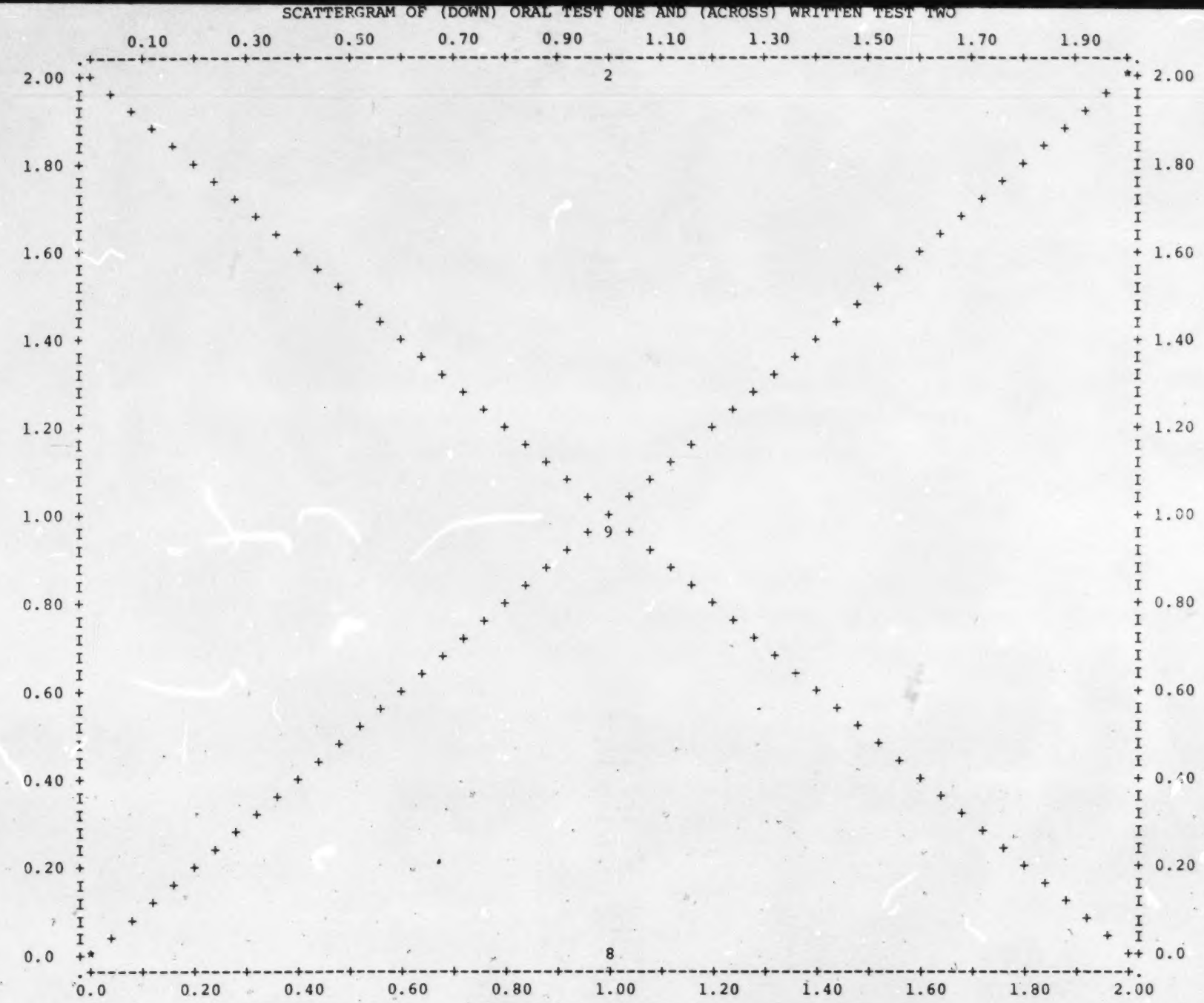
COGNITIVE PROGRAM

Essex County College
303 University Avenue
Newark, New Jersey 07102

APPENDIX H

THE SCATTERGRAM OF

ORAL TEST AND WRITTEN TEST


SCATTERGRAM OF (DOWN) ORAL TEST ONE AND (ACROSS) WRITTEN TEST TWO
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2.00 1.80 1.60 1.40 1.20 1.00 0.80 0.60 0.40 0.20 0.0
2
9
8
0.0 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
STATISTICS: CORRELATION (R)-- 0.41451
R SQUARED -- 0.17182
SIGNIFICANCE --0.00001
STD ERR OF EST -- 0.31364
INTERCEPT (A) -- -0.06000
SLOPE (B) --1.00000
PLOTTED VALUES --100
EXCLUDED VALUES 0
MISSING VALUES 0

SIGNATURE PAGE

I certify that I have read and am willing to sponsor this Major Applied Research Project submitted by AIDEN J. KENNY. In my opinion it conforms to acceptable standards and is fully adequate in scope and quality, as a Major Applied Research Project for the degree of Doctor of Education at Nova University.

H. R. Kells

Herbert Kells
MARP Advisor

I certify that I have read this Major Applied Research Project and in my opinion it conforms to acceptable standards for a Major Applied Research Project for the degree of Doctor of Education at Nova University

David Griffiths
Local Professional

This Major Applied Research Project was submitted to the Central Staff of the Nova University Ed.D. Program for Community College Faculty and is acceptable as partial fulfillment of the requirements for the degree of Doctor of Education.

Eugene E. DuBois

Eugene Dubois
Central Staff Committee Member

ERIC Clearinghouse for Junior Colleges
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University of California
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